Manage the femoral fracture in children has changed during the last decade. Since the introduction of IM (intramedullary) flexible nails, most of them are surgically treated. In children younger than 3 years, conservative management either with skin traction or with hip spica remains the primary treatment method. However, there is an increasing number of reports for surgically treated femoral fractures, even in these young children [1, 2, 3, 4, 5].

Several studies focus on the comparison of the results between surgical and conservative treatment, for children younger than 4 years. They compare the alignment with axis deviation on the frontal and lateral level after management. Hospitalization length and financial expenses remain another issue to compare. However, there are no reported cases on the management of children with transposition of the fragmented femur [6, 7, 8, 9].

We present a 3-year-old boy who was referred to our hospital after a spiral fracture of his right femur. There was transposition of the fragments, with the proximal part shifted medially and the distal part laterally. We informed the parents for the methods of treatment available for his fracture. After 1 week of hospitalization, the child was transferred home, with skin traction, with supervision of an orthopedic surgeon. The child was regularly evaluated with radiological examination, every 10 days. There was an uneventful healing of the fracture, with normal alignment of the leg and acceptable initial leg length discrepancy (LLD). One year after the fracture, there is an impressive remodeling of the fracture with restoration of the medullary canal and absent LLD.

**Conclusion:** Conservative treatment of spiral fracture in a child younger than 3 years is an effective method. Remodeling in this young age can restore not only deviations on the frontal and sagittal plane but also correct the transposition of the fragments with restoration of the medullary canal.

**Keywords:** Femoral fracture children, transposition of fragments, conservative treatment.

**Introduction**
Management of femoral fractures in children has changed during the last decade. Since the introduction of IM (intramedullary) flexible nails, most of them are surgically treated. In children younger than 3 year, conservative management either with skin traction or with hip spica remains the primary treatment method. However, there is an increasing number of reports for surgically treated femoral fractures, even in these young children [1, 2, 3, 4, 5].

Several studies focus on the comparison of the results between surgical and conservative treatment, for children younger than 4 years. They compare the alignment with axis deviation on the frontal and lateral level after management. Hospitalization length and financial expenses remain another issue to compare. However, there are no reported cases on the management of children with transposition of the fractured segments of the femur [6, 7, 8, 9].

We present a 3-year-old boy who was referred to our hospital after a sustained spiral fracture of the femur with transposition of the fragments. After counseling with the parents, we have treated...
him conservatively with skin traction at home, with regular radiological observation. The fracture healed within the expected time and an impressive remodeling of the transposition was observed a year after the fracture.

**Case Presentation**

A 3-year-old boy, with normal height and weight for his age, was referred in our hospital, after he sustained a spiral fracture of his right femur while playing in the yard. The radiological examination showed the long spiral fracture with transposition of the fragments, with the proximal part shifted medially and the distal part laterally. The lateral X-ray had a good alignment of the fracture (Fig. 1a and b). This type of fracture was initially regarded as appropriate for treatment with IM flexible nails in order to restore the transposition of the fragments.

In consultation with his parents, we presented the advantages of the surgical treatment, but also proposed methods of conservative treatment for his age. We proposed the immediate hip spica treatment under anesthesia, with possible improvement of the transposition of the fragments, or the treatment with skin traction either with hospital admission either at home after a short period of hospitalization. We explained that the aim of treatment is the proper alignment and the restoration of leg length equality. His parents preferred the conservative treatment and we treated him with skin traction. We further explained that in event of losing alignment with unacceptable angulations, we will proceed in surgical intervention with IM nails.

He remained for a week in hospital and then transferred home with his skin traction, with the ambulance. A doctor supervised the appropriate placement of the skin traction at home. The progression of the fracture healing was evaluated every 10 days with X-ray. Callus formation appeared on the 3rd week and appropriate callus was evident on the end of the 4th week, when we removed the skin traction, after 1 month (Fig. 2a, b and Figs. 3a, b). There was no change in alignment. The distal part of the proximal fracture appeared with overriding of 1.5 cm both on the AP and lateral views. The child was very tolerant, as the treatment was conducted in his house environment and his family was very supportive.

The child was gradually mobilized as tolerated, with instructions to avoid immediate walking. He started partial weight-bearing at 6 weeks, and by 2 months, he was able to walk without support. Radiological examination at 4 months after the initial fracture showed the maintenance of good alignment and a leg length discrepancy (LLD) of 1.2 cm as measured on the digital X-rays (Fig. 4a and b).

There was already correction of the initial transposition of the fragments. On reviewing him after 1 year time, the child had a normal shape of his leg, without clinical signs of LLD. Final radiological examination confirmed the normal alignment both on AP and lateral views, with 0.8 cm LLD. There was an impressive correction of the shape of the femur, with restoration
of the medullary canal of the femur, while only a smooth line of the transposed cortices remained (Fig. 5a and b).

Discussion

Treatment of femoral fractures in children is correlated with the age of the affected patient. With the introduction of IM flexible nails, children older than 4–5 years old are usually surgically treated. The younger the child, the choice of conservative treatment is more possible as an initial treatment. Conservative treatment is preferred as the initial method in younger children, however with the increasing use of IM nails, children younger than 3 years old are being surgically treated.

In a report among 121 pediatric hospitals in Germany, a total of 756 children with femoral fractures younger than 3 years old were analyzed. A total of 375 children were treated with IM flexible nails, 50% of the total number. Indications for surgical treatment were multiple traumas, increased body weight >20 kg, open fractures, and lack of stable fixation with conservative treatment. A photograph of an 18-month baby with a diaphyseal fracture with <15- degrees varus angulation is presented. As a polytrauma child, management with stabilization with IM flexible nails was elected [10].

In a group of 262 children aged 4 and 5 years old, treatment either with IM nails or spica cast was compared. The authors report that IM nails were used in older, heavier, and with higher energy injury children. It is worth noting that children aged 4 years are mainly treated with spica cast, while in 5 years old, they are mainly surgically treated. Among the children treated with spica, three of them had to change to IM because of unacceptable malalignment in the immediate post-operative treatment. However, in the IM nail group, four children treatment changed and converted to hip spica because of migration of the nail. Among the 104 patients who were surgically managed with IMN, in 13 of them, a supplemental spica cast was used for stability. They report similar results comparing the angulation in coronal and sagittal plane, referring as an acceptable angulation 15-degrees in the coronal plane and 20-degrees in the sagittal plane. Similar differences were found regarding the early fracture shortening < than 2 cm. Shortening was more common in the spica group, but the differences were not statistically significant. Children treated surgically had more clinic visits and underwent another procedure for the removal of the implants. The remaining small scar tissue was not reported as a complication. The authors report that in their institution, it is not a common practice to perform IMN in 2–3 years of age. The authors conclude that families should be informed that IMN is associated with higher risk of complications and that surgical treatment is more expensive.

This approach raised several concerns regarding the choice of treatment regarding the size and weight of the child, the type and comminution of the fracture, associated injuries, or disabilities. The approach of the family regarding their preference and easiness to carry a child with a spica or with a small wound must be evaluated [4].

A systematic review and analysis of femoral shaft fractures in children 2–16 years old treated either with TNM or hip spica favor the use of TNM comparing differences in angulation in the coronal and sagittal plane. There is no reference in the presence of transposition of the fragments [11].

In a multicenter study of 215 children aged 2–6 years, the use of IMN was recommended as it favors activities and ambulation of the children. There were no differences in alignment and healing time between TENS and hip spica. Fractures associated with high-energy mechanism were considered as candidate for treatment with IM nails [12].

Another multicenter review of pediatric femoral shaft fractures for the decade 2004–2013 reports the increasing trend to treat children younger than 5 years (starting from 1.5 years) with TENS after 2009. There is wider consent across the centers involved in the survey that the large percentage of femoral fractures in children younger than 5 years old is treated without surgery. Surgical treatment in this age group is related to comminute unstable fractures, high-energy mechanisms, and soft-tissue injuries that make casting less favorable [13].

In a single center, a retrospective review of 73 children aged 3–6 years old, compared the hospital stay and the financial burden for the treatment between hip spica and TENS. The younger the children, spica was the preferable method (mean age 3.7 years), while older children were treated with TENS (mean age 5.3 years). The use of TENS was associated with longer hospital stay, higher number of clinical visits, and mainly an important increase in hospital charges [9].

Two similar groups of preschool children were compared. The first group with 19 children was treated with hip spica and the second group with 27 children had FIN. The authors report similar results but favor the hip spica treatment that allowed earlier discharge from the hospital with few complications [14].

In a recent report for the treatment of femoral fractures in children 2–6 years old, 75 patients were treated, 39 in hip spica and 36 with TENS. The group that had spica treatment had a younger mean age (2,71 years compared to 3,16 years with the group with TENS). Results were similar and the authors conclude that both methods are effective, but treatment must be individualized, apart from anatomical and biological factors [8].

The use of skin traction, for the treatment of femoral shaft fractures in children younger than 4 years, was evaluated in 10
children, with mean age 2.4 years. The authors report that angular or rotational deformities or LLD did not occur. One child had compartment syndrome. With appropriate patient selection and instructions to parents, the method is simple and effective [1].

The reported patient of our case study had an uneventful healing of his fracture in the expected time. He had a minimal hospital stay, with minimal expenses, requiring only the appropriate home care and supervision of an orthopedic surgeon. His transfer from and to the hospital was easily performed with an ambulance, in the supine position with his skin traction. We were able to maintain the LLD in the minimal possible difference, with the appropriate amount of weight for the skin traction.

We could not find reports in the literature, for the management of transposition of the fragments in children. Despite that the use of IMN is our method of choice for children older than 4 years; we favor the conservative management for younger children. Our option for conservative treatment was to apply a hip spica under anesthesia. We could improve the transposition of the fracture but then that was a clear indication for the use of TENS to stabilize the fragments in the reduced position. We offered the choice of conservative treatment with skin traction, avoiding even the anesthetic for the child. We regularly followed the child, informing the parents that malalignment and unacceptable shortening will be indications for surgical treatment with TENS. The child maintained a good axis both in the coronal and sagittal plane without rotational deformity. There was an impressive remodeling in a year even with restoration of the medullary canal. It is important that the family was able to maintain appropriate care for the child to keep the skin traction in the appropriate alignment.

**Conclusion**

Conservative treatment of spiral fracture in a child younger than 3 years is an effective method. Remodeling at this young age can restore not only deviations on the frontal and sagittal plane but also correct the transposition of the fragments with restoration of the medullary canal.

**Clinical Message**

Pediatric orthopedic surgeons must inform parents that children younger than 3 years can be treated conservatively either with skin traction either with hip spica.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil   **Source of support:** None

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Conflict of Interest: Nil
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Content: The authors confirm that informed consent was obtained from the patient for publication of this case report